Eulerian Transported PDF Framework for Scramjet Flowpath Analysis, Phase I

Completed Technology Project (2012 - 2012)

Project Introduction

Scramjet engines promise to become a next-generation revolutionary technology for aerospace applications. Some of the significant challenges in rapid development of scramjets include complex flow physics; combustion; flow-combustion interactions; propulsion air-frame integration; coupled with difficulty in producing realistic experimental conditions. The role of Computational Fluid Dynamics (CFD), therefore, is crucial in design and development of the scramjet engines. The overall innovation includes development of a comprehensive Eulerian transported PDF methods framework coupled with an efficient RANS/LES flow solvers for simulating high-speed turbulent reacting flows and an innovative chemistry acceleration module achieving up to two orders of magnitude reduction in computing times for the Eulerian TPDF framework. In Phase I feasibility of the proposed Eulerian transported PDF approaches for accurately capturing turbulence-chemistry interactions will be demonstrated and analyzed. In Phase II, we will perform additional developments in the chemistry acceleration module and the Eulerian TPDF framework, such that a comprehensive, turbulent-combustion modeling framework, for low and high-Mach number reacting flows will be available at the end of Phase II.

Primary U.S. Work Locations and Key Partners
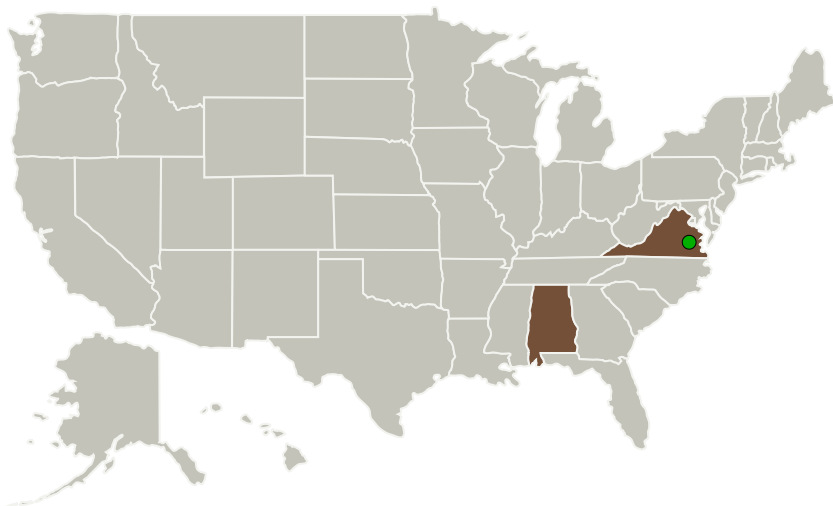
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Organizations Performing Work	Role	Type	Location
CFD Research Corporation	Lead Organization	Industry	Huntsville, Alabama
🟢Langley Research Center(LaRC)	Supporting Organization	NASA Center	Hampton, Virginia

Primary U.S. Work Locations	
Alabama	Virginia

Project Transitions

▶ **February 2012:** Project Start

✔ **August 2012:** Closed out

Closeout Documentation:
- Final Summary Chart*(https://techport.nasa.gov/file/138139)*

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Organization:

CFD Research Corporation

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

Project Management

Program Director:
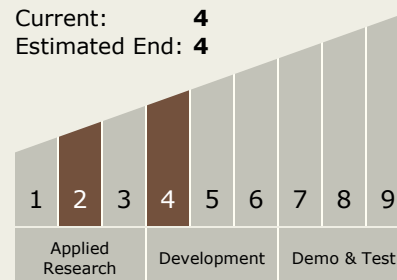
Jason L Kessler

Program Manager:

Carlos Torrez

Principal Investigator:

Ranjan Metha

Technology Maturity (TRL)

Start: **2**
Current: **4**
Estimated End: **4**

1	2	3	4	5	6	7	8	9
	Applied Research		Development			Demo & Test		

Technology Areas

Primary:

- TX15 Flight Vehicle Systems
  └ TX15.1 Aerosciences
      └ TX15.1.7 Computational Fluid Dynamics (CFD) Technologies

Target Destinations

The Moon, Mars, Outside the Solar System, The Sun, Earth, Others Inside the Solar System